New determination of the Ba-Mo yield matrix in spontaneous fission of ^{252}Cf

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Using triple-coincidence events of prompt fission gamma rays from spontaneous fission of ^{252}Cf, which we measured in Gammasphere in 1995, we made a new analysis of the yield matrix of coincident pairs of barium (Z=56) and molybdenum (Z=42) fission fragments. Branching from gamma-bands (*K=2*) and octupole-bands (*K=0*) were also measured. From this reanalysis the previously proposed "extra-hot-fission mode" (8 to 10 neutrons evaporated) is much weaker than first reported. This earlier report of Ter-Akopian *et al.*[1] was based on 2-fold coincidence work from our 1993 Gammasphere data. Our new analysis of 3-fold data of 1995 was recently published.[2] Our finding of the weakness or perhaps absence of the hot fission mode is in agreement with a recent independent study with a gamma detector array in Italy.[3]

The main reason for the differences between the 2-dimensional and 3-dimensional analyses, we believe, arise from the nearly identical energies in the ground rotational bands of 104Mo and 108Mo. The 2D work has a much larger ratio of 104 to 108 than the 3D work for the lightest barium partners. In the 3D analysis double-gating and explicit Compton background subtraction were employed, and the above yield ratio was determined by resolving the 4→2 transitions of 368.4 and 370.9 keV, respectively. The 2D analysis was probably based on the attempt to resolve the much closer 2→0 transitions of 192.2 and 192.9 keV, respectively.

The only significant differences in the Ba-Mo yield matrices in refs. 1 and 2 can be seen in the yield contour plot figure of ref. 2. The extra yield attributed to ^{104}Mo in ref. 1 gives a peninsula extending out to 10-neutron loss, but the peninsula goes away to ^{108}Mo in ref. 2, pushing down the apparent large neutron loss. The earliest 2D published results also showed a higher –10n pairwise yield going to the ^{138}Ba-^{104}Mo partner combination, but this was re cognized and corrected downward in ref. 1. The early higher yield in 2D work probably arose from there being yet another unresolvable gamma ray, the 191.96 keV 6→4 transition in ^{138}Ba. In 2D analysis this transition in coincidence with the 1435.8 keV 2→0 gives apparent –10n yield.

We will soon submit a paper to Nuclear Instruments and Methods in Physics Research. In this paper we show spectra and present gate-selection strategies and Compton background subtraction methodologies.

It cannot be ruled out by 3D work that there could be significant yield to ^{104}Mo that bypasses the 4→2 transition, either by direct population of first excited states of the partners with no other gammas emitted or by some unknown gamma branch. On our recent Gammasphere runs of year 2000 we took some 2D data as well as the bulk of 3D and higher fold. We intend to examine the 2D data for yield missed by 3D events.

It should be evident that yield-matrix determinations of fission partners is very labor intensive and prone to difficulties with unresolvable close-lying gamma rays. There may be much of interest yet to be learned from good yield matrix studies.

Footnotes and References

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1. G.M. Ter-Akopian *et al.* Phys. Rev. C **55**, 1146 (1997)

2. S.-C. Wu *et al.* Phys. Rev. C **62**, 41601 (R) (2000).

3. D.C. Biswas . *et al.* Eur. Phys. J. A **7**, 189 (2000).